

CLAIMS:

1. A switchable optical unit (1; 50; 200; 501; 1501) capable of controlling a beam of radiation (b) passing through an optically active portion (8; 108; 408; 1408) of the unit, which unit comprises a chamber (10; 110; 410; 1410) and an electrically conductive liquid (18; 118; 218; 418; 1418) contained in the chamber and having an index of refraction
5 different from that of its surroundings, the chamber being provided with an electrode configuration (20, 22, 24, 28; 120, 122, 124, 128; 220, 222; 509, 510, 514) wherein application of a voltage (V), from a voltage control system (30, 32, 34, 36, 38, 40, 41, 42; 130, 132, 134, 136, 138, 140, 141, 142; 430, 432, 434, 436, 438, 440, 442) to electrodes causes movement of the said liquid, characterized in that the electrode configuration
10 comprises at least one first electrode (20, 22; 120, 122; 220, 222; 509) fixed to the inner walls (12, 14; 506, 508) of the chamber at the position of the optically active portion (8; 108; 408), second electrode means (24; 124; 510) fixed to the inner walls of the chamber at positions outside the optically active portion and a third electrode (28; 128; 514) in contact with the conductive liquid and continuously connected to a first output (32; 132; 432) of a voltage
15 source (30; 130; 430), a second output (34; 134; 434) of which is connected in a first mode to said at least one first electrode and in a second mode to the second electrode means
2. A switchable optical unit as claimed in claim 1, wherein the second electrode means (24; 124; 510) includes one annular electrode having a U-shaped cross-section.
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3. A switchable optical unit as claimed in claim 1, wherein the second electrode means includes one flat annular electrode.
4. A switchable optical unit as claimed in claim 1, 2 or 3, wherein the interior
25 wall (12, 14; 506) of the chamber facing the liquid is coated with an insulating hydrophobic layer (44; 144; 513).

5. A switchable optical unit as claimed in any of claims 1-4, wherein the chamber comprises a medium (19; 119; 219; 419; 1419) which has an index of refraction different from that of the conductive liquid (18; 118; 218; 418; 1418).
- 5 6. A switchable optical unit as claimed in claim 5, wherein the medium (19; 119; 219; 419; 1419) is a liquid.
7. A switchable optical unit as claimed in claim 5, wherein the medium (19; 119; 219; 419; 1419) is a gas.
- 10 8. A switchable optical unit as claimed in any of claims 1-4, wherein the liquid-less portion of the chamber (10; 110; 210; 410; 1410) is at vacuum.
9. A switchable optical unit as claimed in any one of claims 1-8, comprising at least one lens element (2, 4) wherein at least one chamber wall (12, 14) situated in the optically active portion (8) includes a refractive lens surface.
- 15 10. A switchable optical unit as claimed in claim 9, wherein each of two opposite chamber walls (12, 14) situated in the optically active portion (8) includes a refractive lens surface.
- 20 11. A switchable optical unit as claimed in claim 9 or 10, wherein at least one of the refractive lens surfaces (12, 14, 46, 48) is an aspherical surface.
- 25 12. A switchable optical unit as claimed in any one of claims 1-11, wherein at least one chamber wall (56; 78) situated in the optical active portion (108) is provided with a phase structure (58, 60; 202).
13. A switchable optical unit as claimed in claim 12, wherein the phase structure is a non-periodical structure (202), which renders the unit to a wavefront-modifying unit
- 30 14. A switchable optical unit as claimed in claim 12, wherein the phase structure is a periodical structure (58, 60).

15. A switchable optical unit as claimed in any one of claims 1-14, wherein the voltage control system (30, 32, 34, 36, 38, 40, 41, 42; 32, 134, 136, 138, 140, 141, 142) is arranged to supply a voltage to the at least one first electrode (20, 22; 120, 122; 220, 222) individually.
- 5 16. A switchable optical unit as claimed in any one of claims 1-15, wherein the index of refraction of the electrically conductive liquid (18; 118; 218) is equal to that of the optically relevant material of the chamber wall (12, 14; 112, 114).
- 10 17. An optical camera (300) including a controllable lens system, wherein the lens system (1; 302) comprises a switchable optical unit as claimed in any one of claims 1-11.
18. A hand-held apparatus including an optical camera (300) as claimed in claim 17.
- 15 19. A switchable optical unit as claimed in any one of claims 1-8, wherein at least one chamber wall (506, 508) situated in the optically active portion (408) includes a planar surface.
- 20 20. A switchable optical unit as claimed in claim 19, wherein each of two opposite chamber walls (506, 508) situated in the optically active portion (408) includes a planar surface.
- 25 21. An optical head (360) for scanning an information layer (354) and comprising a radiation source unit (362) for supplying a scanning beam (364, 374), an objective system (370) for focusing the scanning beam (374) to a scanning spot (380) in the information layer and a radiation-sensitive detection unit (384) for converting scanning beam radiation (390) from the information layer in electrical signals, the radiation source being switchable to emit a read beam and a write beam respectively, wherein the optical head comprises a diffraction
30 element (392) for both the read beam and the write beam in the form of a switchable grating unit (50) as claimed in claim 14.
22. An optical head (360) for scanning an information layer (354) and comprising a radiation source unit (362) for supplying a scanning beam (364, 374) an objective system

(370) for focusing the scanning beam (374) to a scanning spot (380) in the information layer (354) and a radiation-sensitive detection unit (384) for converting scanning beam radiation (390) from the information layer in electrical signals, the radiation source being switchable to emit a read beam and a write beam respectively, wherein the optical head comprises a
5 diffraction element (392) for the read beam only in the form of a switchable grating unit (50) as claimed in claim 16.

23. An optical head (360) for scanning an information layer (354) and comprising a radiation source unit (362) for supplying a scanning beam (364, 374), an objective system
10 (370) for focusing the scanning beam (374) to a scanning spot (380) in the information layer and a radiation sensitive detection unit (384) for converting scanning beam radiation (390) from the information layer in electrical signals, the radiation source unit emitting at least two scanning beams of different wavelengths for scanning at least two information planes of different formats, wherein the optical head comprises a beam deflecting element in the form
15 of a switchable phase structure (50) as claimed in claim 16 to align the axis of the at least two beams having different wavelengths.

24. An optical head (360) for scanning an information layer (354) and comprising a radiation source unit (362) for supplying a scanning beam (364, 374), an objective system
20 (370) for focusing the scanning beam (374) to a scanning spot (380) in the information layer and a radiation-sensitive detection unit (384) for converting scanning beam radiation (390) from the information layer in electrical signals, the radiation source emitting at least two scanning beams of different wavelengths for scanning at least two information planes of different formats, wherein the optical head comprises a three-spot grating (392) in the form
25 of a switchable phase structure (50) unit as claimed in claim 14.

25. An optical head (360) for scanning an information layer (354) and comprising a radiation source unit (362) for supplying a scanning beam (364,374), an objective system
30 (370) for converging the scanning beam (374) to a scanning spot (380) in the information layer and a radiation-sensitive detection unit (384) for converting scanning beam radiation (390) from the information layer in electrical signals, the radiation source emitting at least two scanning beams of different wavelengths for scanning at least two information planes of different formats, wherein the objective system comprises in addition to a refractive lens

system (370) a wavefront-modifying unit (368) in the form of a switchable phase structure unit (50; 200) as claimed in claims 14, 15, 16 or 17.

26. An optical head (360) as claimed in claim 25, wherein the wavefront-modifying unit (50; 200) is incorporated in the refractive lens system (370).

27. An optical head (360) for scanning a format having a first information layer (522) in an information plane and a second information layer (524) in a different information layer plane, said optical head comprising a radiation source unit (1362) for supplying a scanning beam (1364, 1382), an objective system (525) for focusing the scanning beam (1364, 1382) to a scanning spot (1380) in one information layer and a radiation-sensitive detection unit (384) for converting scanning beam radiation (1390) from the one information layer into electrical signals, wherein the objective system comprises a switchable optical element (501; 1501) as claimed in claim 20 for switching the scanning spot between the first and second information planes.